

Thesis Project Portfolio

Development of a novel fetal heart rate triangulation algorithm for multiple gestation pregnancies

(Technical Report)

A Care Ethics Analysis of Electronic Fetal Heart Rate Monitoring Malpractices

(STS Research Paper)

An Undergraduate Thesis

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

In my technical project my team and I constructed a novel fetal heart rate triangulation algorithm to better detect fetal heart rates during multiple gestation pregnancies. My STS research is tightly connected to my capstone project, given that I explored the malpractices that can occur during fetal monitoring, and the impact that these can have on both the fetus and the pregnant mother. For reference, fetal heart rate monitoring with a Doppler Ultrasound is the *de facto* method for monitoring the health of the fetus, and it has not had any major improvements in the past five decades. Both my technical and my STS works explore pregnancy and monitoring, although my capstone project is more focused on multiple gestation pregnancies (i.e. twins, triplets, etc), and my STS explores overall fetal monitoring.

My technical work explores the creation of a novel triangulation algorithm to detect two unique fetal heart rates in 3D space. The idea behind this is that right now, current fetal heart rate monitoring for multiple fetuses utilizes up to two Doppler ultrasounds transducers, which may mistakenly record one fetus's heart rate twice, leaving the other fetus unmonitored and in great danger. Also, fetal monitoring currently requires the manual handling and placing of a nurse of the ultrasound transducer which makes it really inconvenient in the case of movement or epidural injection placement. With this new technology, our aim is that these electrodes can be placed in the pregnant mother's belly once, and not require the manual placing of the device since the algorithm detects the heart rates in 3D space with depth and length.

My STS focuses more on the ethical side of fetal heart rate monitoring, and the implications malpractices could have on both the fetus and the baby. For my STS research paper, I utilized a care ethics approach to discuss how the malpractices in fetal monitoring were unethical and bring irreparable harm to the fetus. I studied two different incidents, one which

happened in October of 2003, where the medical staff failed to correctly monitor the fetus, unable to provide a timely cesarean delivery, depriving the fetus from oxygen for way too long. The other incident I studied happened in 2005, where the medical staff failed to monitor the baby correctly, missing key changes in his heart rate that were indicating serious health problems. With the care ethics approach, I evaluated where the medical staff failed to be attentive, responsible, and competent with regards to the care given to the mother and fetus, and how this negligence in care was unethical and caused irreparable repercussions.

Working on these two projects simultaneously gave me great insight for both. On one end, I could see my capstone project as something more than just technical, but I could see how this algorithm can change the fetal monitoring as it is right now, and perhaps prevent some of the malpractices I discussed in my STS research. On the other hand, it was very interesting to find out that most of the malpractices that occur with regards to fetal monitoring are due to a malpractice of the medical professionals, and not necessarily the device itself. While the technology has not changed in the last five decades and definitely needs improvement, it is really interesting to see the technology needing to work hand in hand with a medical professional, as it is imperative for the success of a pregnancy and birth. Overall, working on these two projects has gave me more insight on what it means to be a professional, and all the ethical implications that come with it.